CONTAINERLESS EXPERIMENTATION IN FLUID DYNAMICS AND CRYSTAL GROWTH ON EARTH AND IN MICROGRAVITY

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The experimental techniques used for the investigation of the shape dynamics and flows within single isolated fluid particles have been refined to the point where detailed differences between phenomena observed in 1 G and in microgravity can be accurately measured. The judicious combination of the capabilities of ultrasonic and electrostatic levitation schemes, together with the introduction or modification of non-contact diagnostic methods have led to some progress in our understanding of the effects of high intensity levitation fields on drop and bubble dynamics and on flow-induced perturbations found in 1 G. In turn, this information allows the rigorous evaluation of the gravitational contribution to phenomena relevant to free surface dynamics , to transport processes in disperse systems, and to crystal growth from levitated solution drops.Some recent experimental results have been obtained concerning the nonlinear dynamics of free drops and bubbles in 1 G and in microgravity. Specific indirect effects of gravity on the nonlinear dynamics of shape oscillations of bubbles have been identified and the detailed evaluation of a single particle ultrasonic positioning system has been carried out in the NASA Glovebox facility in microgravity. These results imply that the enhanced symmetry offered by the microgravity conditions would yield qualitatively different results for bubbles undergoing large-amplitude oscillations within a restraining field. The recent flight investigation results also suggest that very simple ultrasonic positioning devices could be used in low-gravity to carry out accurate measurements of phenomena associated with single isolated droplets. Finally, recent experiments in 1-G have also provided new information concerning thermocapillary flows within a levitated laser-heated drop, and about the protein crystal growth process in levitated solution drops rotating along a horizontal axis. [Research funded by the NASA Microgravity Research Division]